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NAVSHIPS

Technical Manual

Instrument Calibration Procedure

AP-09

AUDIO LEVEL METER

ME-2U

AND

GENERAL RADIO 783A

DEPARTMENT OF THE NAVY CALIBRATION PROGRAM

PUBLISHED BY DIRECTION OF
THE COMMANDER OF THE NAVAL AIR SYSTEMS COMMAND

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FOREWORD

This procedure has been prepared specifically for those laboratories participating in the Navy Calibration Program. The government assumes no responsibility for its use by other agencies.

The instruments utilized in this procedure were selected from those known to be at the disposal of the participating laboratories, and the listing by make and model number carries no implication of preference, recommendation, or approval by the Navy for use by other agencies. It is recognized that equivalent equipment produced by other manufacturers may be capable of equally satisfactory performance in the procedure.

This procedure was prepared for the
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All comments concerning this procedure should be directed to the Metrology Engineering Center.

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SECTION 1

INTRODUCTION AND DESCRIPTION

1.1 This procedure describes the calibration of the ME-2/U and General Radio 783-A Output Power Meters which are designed to measure and indicate the output power of audio frequency devices. The instrument being calibrated will be referred to herein as the Test Instrument.

Table 1. Calibration Description

Test Instrument Characteristics	Performance Specifications	Test Method
Impedance	Range: 2.5 to 20,000Ω in 40 steps Limit of error: ± 2%	Selected Test Instrument input impedances are measured with an impedance bridge.
Power measurement	Range: .01, .1, 10, and 100 watts full scale Limit of error: ± 0.25 db at full scale	The voltage component of the applied power is measured with an A-V differential voltmeter.
Frequency response	Range: 20 Hz to 15 kHz Flatness: ± 0.5 db from 20 Hz to 10 kHz, ± 0.75 db from 10 to 15 kHz	A constant amplitude, variable frequency signal is applied to the Test Instrument. The Test Instrument indicated deviation from a reference level is observed.

SECTION 2

EQUIPMENT REQUIREMENTS

NOTE

Minimum use specifications are the principal parameters required for performance of the calibration, and are included to assist in the selection of alternate equipment. The selection of equipment other than that designed is the responsibility of the supervisor of the calibrating activity. Correct performance of alternate items should be verified by operational tests. All applicable equipment must bear evidence of current calibration.

Item	Minimum Use Specifications	Calibration Equipment
2.1 Impedance bridge	Range: 2 to 20,500 Ω Limit of error: ± 0.5% plus not more than 10 milliohms	Electro-Scientific Ind. 250A or ZM-11
2.2 Autotransformer	Input: 115 volts, 60 Hz, 1 Ø Output: 0 to 100 volts metered Current: 5 amperes max	General Radio W5MT3A or W10MT3A
2.3 Autotransformer	Same as Item 2.2	Same as Item 2.2
2.4 Oscillator	Waveform: sinewave Amplitude: variable 0 to 3 volts rms into 600 Ω Frequency: 20 Hz to 20 kHz Limit of error: ± 5% Distortion: 1% maximum	Hewlett Packard 200 CD or 200 SR; or General Radio 1210 C with a 1203 B power supply
2.5 A-V EVM	Range: 0 to 3 volts rms Frequency response: 20 Hz to 15 kHz Limit of error: ± 2% of full scale	Hewlett Packard 400 H or L
2.6 A-V differential voltmeter	Frequency response: 60 Hz Range: capable of measuring 0.700 to 110.0 volts rms Limit of error: ± 0.2% of indicated reading Input impedance: not less than 100 k Ω	Fluke 803 series

SECTION 3

PRELIMINARY OPERATIONS

3.1 Visually inspect the Test Instrument for any defects.

3.2 If necessary, mechanically zero the Test Instrument meter.

3.3 Set the Test Instrument controls as follows:

IMPEDANCE MULTIPLIER switch to	1
OHMS switch to	25
POWER MULTIPLIER push-button to	1 WATTS

3.4 Set all auxiliary equipment controls as necessary to avoid damage to the equipment, and so that dangerous voltages will not be present on output terminals when power switches are turned on.

3.5 Connect all auxiliary equipment to the applicable power source.

3.6 Set all power switches to on.

3.7 Allow approximately 30 minutes for warm up.

SECTION 4

CALIBRATION PROCESS

4.1 IMPEDANCE TESTS

4.1.1 Connect the applicable equipment as shown in figure 1.

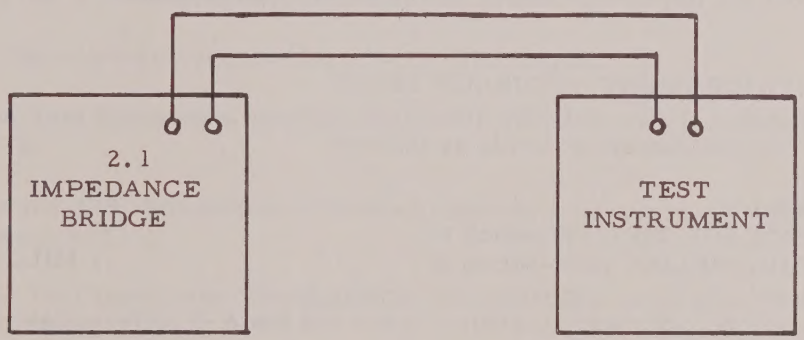

Figure 1. Impedance Test Configuration

4.1.2 Short the Test Instrument INPUT terminals. Measure and record the residual resistance of the impedance bridge and interconnecting leads. Remove the short circuit jumper.

4.1.3 Measure the Test Instrument input impedance, subtract the residual impedance value recorded in step 4.1.2 and verify that the remainder is between 24.5 and 25.5 ohms.

4.1.4 Set the Test Instrument OHMS and MULTIPLIER switches to the position listed below. At each setting measure the Test Instrument input impedance and verify that the value is within the limits specified.

Test Instrument Settings		Impedance Bridge Indication In Ohms		
OHMS Switch	MULTIPLIER Switch			
30	1	29.40	to	30.60[a]
40	1	39.20	"	40.80"
50	1	49.00	"	51.00"
60	1	58.80	"	61.20"
80	1	78.40	"	81.60"
100	1	98.00	"	102.0
125	1	122.5	"	127.5
150	1	147.0	"	153.0
200	1	196.0	"	204.0
25	0.1	2.450	"	2.550[a]
200	10	1960	"	2040
200	100	19,600	"	20,400

[a] Subtract the residual impedance value recorded in step 4.1.2 from the measured impedance.

4.1.5 Disconnect the impedance bridge from the Test Instrument.

4.2 POWER MEASUREMENT ACCURACY TESTS.

4.2.1 Set the Test Instrument controls as follows:

OHMS switch to	60
IMPEDANCE MULTIPLIER switch to	10
POWER MULTIPLIER push-button to	1 MILLIWATT

4.2.2 Set both autotransformer controls to zero and the A-V differential voltmeter controls to measure approximately 1 volt.

4.2.3 Connect the applicable equipment as shown in figure 2.

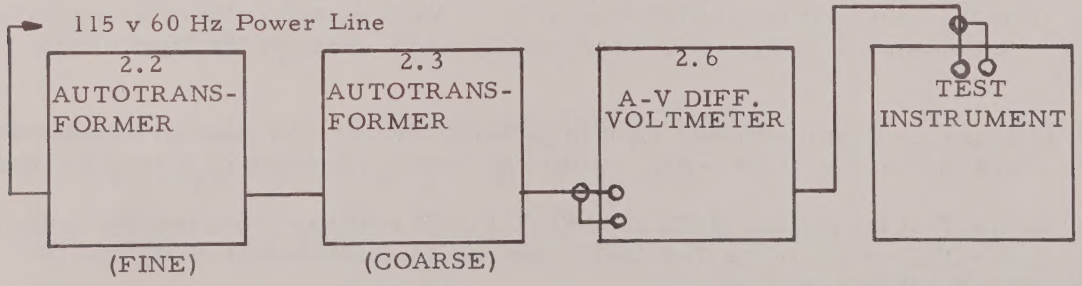

Figure 2. Power Measurement Test Configuration

4.2.4 Adjust the autotransformers labeled COARSE and FINE in figure 2 until the Test Instrument indicates the values listed below. At each indication verify that the A-V differential voltmeter indication is within the specified limits.

Test Instrument Indication (milliwatts)	A-V Differential Voltmeter (rms volts)
1	0.63 to 0.918
2	0.95 " 1.23
4	1.41 " 1.69
6	1.76 " 2.04
8	2.05 " 2.33
10	2.31 " 2.59

4.2.5 Adjust the autotransformers for zero volts output.

4.2.6 Set the Test Instrument controls as follows:

OHMS switch to	100	
IMPEDANCE MULTIPLIER switch to	.1	
POWER MULTIPLIER push-button to	10	MILLIWATT

4.2.7 Adjust the autotransformers labeled COARSE and FINE in figure 2 for an indication of 10 on the upper scale of the Test Instrument meter.

4.2.8 Record the A-V differential voltmeter indication.

4.2.9 Adjust the autotransformers for a zero volts output.

4.2.10 Set the Test Instrument IMPEDANCE MULTIPLIER to 1 and POWER MULTIPLIER to .1 WATTS.

4.2.11 Adjust the A-V differential voltmeter controls to measure 10 volts and repeat steps 4.2.7 through 4.2.9.

4.2.12 Set the Test Instrument IMPEDANCE MULTIPLIER to 10 and POWER MULTIPLIER to 1 WATTS.

4.2.13 Adjust the A-V differential voltmeter controls to measure 100 volts and repeat steps 4.2.7 through 4.2.9.

4.2.14 Set the Test Instrument IMPEDANCE MULTIPLIER to 1 and POWER MULTIPLIER to 10 WATTS and repeat steps 4.2.7 through 4.2.9.

4.2.15 Disconnect all auxiliary equipment from the Test Instrument.

4.3 FREQUENCY RESPONSE TEST.

4.3.1 Set all applicable equipment controls to insure no damage will result to equipment or Test Instrument.

4.3.2 Connect the applicable equipment as shown in figure 3.

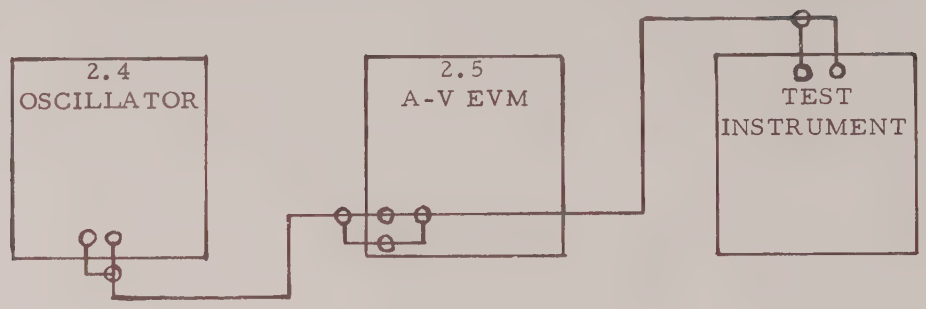

Figure 3. Frequency Response Test Configuration

4.3.3 Set the Test Instrument controls as follows:

IMPEDANCE MULTIPLIER switch to	10
OHMS switch to	60
POWER MULTIPLIER push-button to	1 MILLIWATTS

4.3.4 Set the EVM to measure approximately 3 volts.

4.3.5 Adjust the oscillator controls for an output frequency of 400 Hz and a 9 db indication on the Test Instrument meter. Note the EVM indication.

4.3.6 Adjust the oscillator frequency controls to the following frequencies maintaining the same EVM indication noted in step 4.3.5. At each oscillator frequency record the Test Instrument meter indication.

20 Hz	1 kHz	10 kHz	15 kHz
100 "	2 "	11 "	
400 "	5 "	13 "	

4.3.7 Adjust the oscillator controls for a minimum output. Disconnect all equipment from the test configuration.

4.3.8 Set all auxiliary equipment controls as necessary to avoid damage to the equipment when their power switches are turned off.

4.3.9 Turn all power switches to off.

TEST INST (S):
ME-2/U or GEB 738-A Output Power Meter

PROC NO. NW 17-20AP-09 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)		NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
3.1	Inspection			ck ( )			no defects
3.2	Zero adj			ck ( )			adjust as necessary
4.1	Impedance Tests						
4.1.2	Residual resistance Ref.			Ω			
	OHMS	MULT					
4.1.4	25	1	25 Ω	Ω			24.50 to 25.50 Ω
"	30	"	30 "	"			29.40 " 30.60 "
"	40	"	40 "	"			39.20 " 40.80 "
"	50	"	50 "	"			49.00 " 51.00 "
"	60	"	60 "	"			58.80 " 61.20 "
"	80	"	80 "	"			78.40 " 81.60 "
"	100	"	100 "	"			98.00 " 102.0 "
"	125	"	125 "	"			122.5 " 127.5 "
"	150	"	150 "	"			147.0 " 153.0 "
"	200	"	200 "	"			196.0 " 204.0 "
"	25	0.1	2.5 "	"			2.450 " 2.550 "
"	200	10	2000 "	"			1960 " 2040 "
"	200	100	20 k "	"			19.6 " 20.4 k
4.2	Power Measurement Accuracy Tests						
4.2.4	10 MW Range (1 mw)		0.775 V	V			0.63 to 0.918 V
"	" " (2 mw)		1.09 "	"			0.95 " 1.23 "
"	" " (4 mw)		1.55 "	"			1.41 " 1.69 "
"	" " (6 mw)		1.90 "	"			1.76 " 2.04 "
"	" " (8 mw)		2.19 "	"			2.05 " 2.33 "
"	" " (10 mw)		2.45 "	"			2.31 " 2.59 "
4.2.8	100 " (100 mw)		1 "	"			0.944 " 1.06 "
4.2.11	1 W Range (1w)		10 "	"			9.441 " 0.59 "
4.2.13	10 " " (10w)		100 "	"			94.41 " 105.9 "
4.2.14	100 " " (100w)		100 "	"			"
4.3	Frequency Response Tests						
4.3.6	20 Hz		9 db	db			8.5 to 9.5 db
"	100 "		"	"			" "

TEST INST (S):
ME-2/U or GEB 738-A Output Power Meter

PROC NO. NW 17-20AP-09 MFR MODEL SER NO.

PROCEDURE STEP NO. (1)	FUNCTION TESTED (2)	NOMINAL (3)	MEASURED VALUES FIRST RUN (4)	MEASURED VALUES SECOND RUN (5)	OUT OF TOL ✓ (6)	CALIBRATION TOLERANCES (7)
4.3	Frequency Response Tests (cont'd)					
4.3.6	400 Hz	9 db	db			8.5 to 9.5 db
"	1 kHz	"	"			"
"	2 "	"	"			"
"	5 "	"	"			"
"	10 "	"	"			"
"	11 "	"	"			8.25 to 9.75 db
"	13 "	"	"			"
"	15 "	"	"			"